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(54) **Disposable absorbent nonwoven structure.**

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Disposable absorbent nonwoven structure

The invention relates to disposable, nonwoven, absorbent structures and particularly to such structures characterized by synergistic absorbency, excellent wet and dry bulk, low lint discharge and a cloth-like aesthetic.

The absorbent structures of the present invention have many applications and in fact may be used wherever their unique absorbency and wet and dry bulk characteristics would be advantageous. By careful selection of the materials constituting the alternate layers of absorbent nonwoven material and nonwoven hydrophobic thermoplastic material, the absorbent structures of the present invention may be engineered to serve many appropriate end uses.

While not intended to be so limited, the absorbent structures of the present invention will be described primarily in terms of their application as surgical sponges. The choice to so describe the absorbent structures has been made for two reasons. First of all, the absorbent structures of the present invention lend themselves particularly well to such surgical applications, and secondly, the requirements for such surgical applications are generally far more stringent than those for other applications.

Of the various types of known surgical sponges, one which is very commonly used is generally known as a laparotomy sponge, pad or strip. While its use is not necessarily so limited, the name of this type of sponge is derived primarily because it is extensively employed in laparotomy procedures involving entrance into the abdominal cavity through the abdominal wall. Laparotomy sponges have many applications, frequently involving introduction of the sponge into the wound or abdominal cavity. They are used, for example, to absorb large quantities of blood, body fluids or the like, to "wall-off" organs not involved in the surgical procedure and to assist in the handling of organs. Laparotomy sponges have hitherto most commonly been made of a plurality of plies of cotton gauze sewn together, or of gauze plies surrounding a core of absorbent material.

Laporatomy sponges made of cotton gauze are normally intended for reuse and are characterized by a number of disadvantages. First of all, gauze sponges are relatively expensive and, to achieve adequate absorbency, a relatively large number of gauze plies is required. Since such gauze structures are intended for reuse, this involves the time and expense of washing and sterilization together with the individual hand work required in sorting, folding and the like. Reusable structures always involve some danger of cross-contamination. Furthermore, cotton gauze structures of this type are subject to linting and lint, when left in a wound r in the body cavity, may lead to such post-operative problems as inflammation, adhesions and the formation of granulomas.

Despite these various drawbacks, cotton gauze sponges are characterized by good surface aesthetics inclusive of surface texture and hand. They also possess adequate wet and dry bulk.

Exemplary gauze sponges are disclosed in U.S. Patent No. 3,698,393, 3,837,344, 4,068,666, 3,965,907, and 3,971,381.

Prior art workers have turned their attention to the provision of disposable surgical sponges, attempting to equal or better the advantages of gauze sponges, while overcoming their disadvantages. Examples of such disposable sponges are disclosed in U.S. Patent No. 3,837,950, 3,683,921, 3,566,871, 3,961,629, and 3,867,935 in the last of which there is described a laparotomy pad comprising a plurality of plies of hydraulically entangled hydrophilic fibers interlayered with thin thermoplastic grids.

U.S. Patent 3,214,323 also discloses laminated fibrous nonwoven structures which can be used as surgical sponges in which one or more layers of heat shrinkable fibres of basis weight 40—200 grains/yd^2 are interspersed with layers of non heat shrinkable fibres of basis weight 40—200 grains/yd^2 and heat treated to provide a bulked fabric having enhanced surface texture.

The disposable non-woven structures and surgical sponges of the present invention are easily and inexpensively manufactured, are intended to be disposable and are free of the disadvantages possessed by prior art gauze structures. The disposable non-woven absorbent structures of the present invention demonstrate excellent web and dry bulk in combination with synergistic absorbency and cloth-like aesthetics. The phrase "cloth-like aesthetics" as used herein refers to softness, tactility, texture appearance and other properties contributing to the overall impression of the material. Of particular importance in surgical uses is the fact that these nonwoven absorbent structures are essentially free of lint or particulate discharge. They are possessed of excellent drape, conformability, pliability and softness and are non-abrasive to delicate tissue. The hydrophobic thermoplastic layers can serve as dry adhesive, enabling the structures to be minimally heat bonded. This is advantageous as it enables structures, intended for surgical uses, to be free of additional bonding agents and other additives such as surfactants (including wetting agents), surface finishes and the like, which might leach into a wound.

According to the present invention there is provided an absorbent nonwoven structure comprising layers of nonwoven absorbent material and nonw ven hydrophobic thermo-

plastic material disposed alternately with absorbent layers forming both of the outermost layers, the layers being spot bonded together, wherein the absorbent and thermoplastic layers are free of binding and wetting agents, each of the nonwoven hydrophobic thermoplastic layers having a basis weight of 5—25 g/m² and an open area of at least 40%, and each thermoplastic layer having a structure such that, when positioned between the absorbent layers, it will provide support therefor and void volume therebetween so as thereby to increase the absorbency of the structure. The number of layers of absorbent nonwoven material and nonwoven hydrophobic thermoplastic material does not constitute a limitation on the present invention with the exception that there should always be one more layer of absorbent nonwoven material than nonwoven hydrophobic thermoplastic material.

The nonwoven absorbent material may comprise spun-bonded rayon webs or webs of air laid, wet laid or carded rayon fibers of staple length or longer, with or without mechanical or hydraulic needling. Where the outer nonwoven absorbent layers are desired to have dimensional stability, improved tensile strength and resistance to surface abrasion, they may comprise stabilized rayon webs, as will be defined hereinafter. When the ultimate desired characteristics of the absorbent structure will permit, the inner absorbent layers may comprise other cellulosic materials such as layers of tissue, fluff, wadding and the like.

The hydrophobic thermoplastic material may comprise one or more webs of any appropriate polymer and of any structural web-like form having an open area sufficient to permit the free passage of liquids therethrough.

When the absorbent structures of the present invention are intended for use as surgical aids, such as laparotomy sponges, the preferred absorbent layer material is continuous filament spunbonded rayon. The preferred hydrophobic thermoplastic layer material is a web of polypropylene or polyethylene. Such absorbent and hydrophobic thermoplastic layers are generally recognized to be safe for surgical uses.

Exemplary embodiments of the present invention may take the form of laparotomy sponges preferably comprising alternate webs of spunbonded rayon and extruded and embossed polyethylene or expanded polypropylene. Both extruded and embossed polyethylene webs and expanded polypropylene webs may be used in the same sponge structure.

The individual webs or layers of the absorbent structures should be minimally bonded to each other. This can be accomplished by edge and spot heat bonding utilizing the hydrophobic thermoplastic nonwoven layers as dry adhesives. This assures that the surgical structures will be free of additional bonding agents. The layers of the absorbent surgical structures should also be free of all additives such as surface finishes, surfactants (including wetting agents) and the like.

The absorbent structures of the present invention demonstrate excellent wet and dry bulk along with synergistic absorbency. They are further characterized by little or no lint of particulate discharge and by a cloth-like aesthetic, inclusive of quietness and good hand.

Figure 1 is a fragmentary, semi-diagrammatic, cross sectional view illustrating an exemplary disposable nonwoven absorbent of the present invention in the form of a surgical laparotomy sponge.

Figure 2 is a fragmentary plan view of the laparotomy sponge of Figure 1 illustrating the spot bonding thereof.

Figures 3 through 5 are fragmentary, semi-diagrammatic, cross sectional views illustrating various additional embodiments of laparotomy sponge.

Figure 6 is a graph plotting water absorbed in grams per square centimeter against basis weight in grams per square meter and illustrating the synergistic absorbency of the structures of the present invention.

The disposable nonwoven absorbent structures of the present invention comprise alternate layers of nonwoven absorbent material and nonwoven hydrophobic thermoplastic material. The layers of absorbent nonwoven material may comprise webs of continuous filament spunbonded rayon or webs of the air laid, wet laid or carded rayon fibers of staple length or longer (i.e. at least 1.0 cm), with or without mechanical or hydraulic needling. The absorbent layers or webs should have a basis weight within the range of from 20 to 75 g/m² and preferably 20 to 35 g/m².

When the absorbent structures of the present invention take the form of surgical aids such as laparotomy sponges, it is preferred that the absorbent layers constitute webs of continuous filament spunbonded rayon. Excellent results have been achieved utilizing a continuous filament, nonwoven, spunbonded rayon web produced by Asahi Chemical Industries, Limited, of Osaka, Japan and sold under the trademark "Bemliese". This material is taught in U.S. Patent 3,906,130 in the names of Takashi Tsurumi, Shuichi Emori, Kiyokazu Diagoh, Takemi Ikegami and Tutomu Kenko, issued September 16, 1975. This continuous filament spunbonded rayon web is particularly advantageous in that it is fabric-like, being soft, pliable, comformable and possessing excellent drape and hand. Since this web is a continuous filament web, the available particulate matter or lint which can fall off or be released from the web is greatly reduced due to the absence of fiber ends which could break off when the web is subjected to mechanical energy. The web has an excellent surface texture enabling it to readily wipe up liquids (including relatively

viscous liquids) and liquids containing solids. At the same time, the surface of this web is non-abrasive to delicate tissue. "Bemliese" contains no additives such as surface finishes, surfactants (including wetting agents) or bonding agents which might leach into a wound.

Another excellent rayon web starting material is sold by E. I. Dupont de Nemours, of Wilmington, Delaware under the trademark "Sontara". This rayon web comprises a carded or air laid web of staple length rayon fibers which have been hdyraulically needled. This web has excellent cloth-like and surface characteristics and contains no additives or bonding agents.

When it is desired that the outermost nonwoven absorbent layers of an absorbent structure be characterized by improved tensile strength, dimensional stability and resistance to abrasion, a stabilized spunbonded rayon web or a stabilized discontinuous fiber rayon web may be used. Such stabilized rayon webs are taught in commonly owned European Patent Application No. 79200283.4, Publication No. 0006263, and entitled A STABILIZED RAYON WEB AND STRUCTURES MADE THEREBY. Briefly, an appropriate rayon web such as "Bemliese" or a discontinuous rayon fiber web having substantial fiber orientation perpendicular to the plane of the web, is stabilized by having a thermoplastic web melted into the rayon web from the bottom surface thereof to a controlled penetration depth of from 10% to 40% of the thickness of the rayon web. As a result, the cross over points of the rayon fibers are effectively stabilized from the bottom surface of the web up to the controlled penetration depth therein, while the aesthetics of the upper surface of the rayon web are undisturbed.

The nonwoven hydrophobic thermoplastic layers of the absorbent structures of the present invention may constitute one or more thermoplastic webs of any appropriate polymer and any web-like structural form having an open area so as to freely pass liquid therethrough (i.e. an open area of at least 40%). The thermoplastic web material should be hydrophobic and should have a basis weight of from 5 to 25 g/m². The thermoplastic web may constitute an expanded film, an extruded and embossed web, a melt blown web or a spunbonded web.

The polymers from which the nonwoven hydrophobic thermoplastic webs are made can vary widely. Polyethylene polypropylene, ethyl vinyl acetate, ethylene methyl acrylate, polyurethane, polyester or nylon can be used. The nonwoven hydrophobic thermoplastic webs should have a relatively low melting point of from 110°C to 177°C and preferably from 121°C to 149°C, if heat bonding is to be used. Polyethylene and polypropylene are of particular interest in disposable absorbent structures intended for surgical use. This is true because these polymers are generally recognized to be safe in such applications. Nonwoven hydrophobic thermoplastic webs which have been used in the disposable nonwoven absorbent structures of the present invention with excellent results are manufactured by Hercules, Inc. of Wilmington, Delaware, under the trademark "Delnet". "Delnet" is a thermoplastic web made by a process of extrusion, embossing and orientation. The embossing technique employed in the manufacture of this web may result in a product having a surface pattern which may be generally described as a series of hexagonal bosses connected to each other by a plurality of bars. "Delnet" has an open area of from 45% to 50%, which allows free passage of fluids therethrough and enhances the pliability, drape and aesthetic properties of the thermoplastic web. "Delnet" can readily be heat spot bonded to a rayon absorbent web. Good results have been obtained utilizing "Delnet" having a boss count of from 7 to 10 per centimeter.

Excellent results have also been achieved utilizing a thermoplastic web manufactured by PNC Corporation of Akron, Ohio, under the trademark "Sharnet". This thermoplastic material comprises an expanded and opened film of polymers of the type listed above, of blends thereof. "Sharnet" is soft, very drapable and conformable. It has an open area such as to allow the free passage of fluids therethrough and it can be readily heat spot and edge bonded to a rayon web. Good results have been achieved utilizing "Sharnet" having an open area similar to that of the above mentioned preferred form of "Delnet".

The thermoplastic material should be of such nature that when positioned between the absorbent layers it provides support therefor and void volume therebetween.

Absorbent nonwoven rayon webs in general demonstrate low wet bulk. As used herein the phrase "wet bulk" relates to the resistance to the loss of form and resiliency when wet. This is true, for example, of "Bemliese", mentioned above. It has been found, however, that when such webs are alternately plied with the nonwoven, hydrophobic, thermoplastic webs such as "Delnet" or "Sharnet", the resulting structure demonstrates wet bulk equal to or greater than equivalent structures made of gauze plies.

An exemplary disposable, nonwoven, absorbent structure is illustrated in Figure 1. The Figure is a semi-diagrammatic cross sectional view illustrating an embodiment of a surgical laparotomy sponge. The sponge is generally indicated at 1 and comprises a plurality of nonwoven absorptive layers 2 through 5 with layers of nonwoven, hydrophobic, thermoplastic webs 6, 7 and 8 located therebetween. An exemplary laparotomy sponge of the type illustrated in Figure 1 was made up wherein the layers 2 through 5 were "Bemliese" webs and the layers 6 through 8 were "Delnet" webs. In Figure 1 (and Figures 3

through 5 to be described hereinafter) the individual webs or layers have been greatly exaggerated in thickness, for purposes of clarity.

The plies 2 through 8 of laparotomy sponge 1 should be minimally bonded together. This is accomplished by spot bonding. The term "spot bonding" as used herein and in the claims is intended to be inclusive of continuous of discontinuous pattern bonding, uniform or random point bonding or combinations thereof, all as are well known in the art. Such spot bonding is accomplished by means of heat spot bonding, taking advantage of the presence of the alternate hydrophobic thermoplastic layers or webs which serve as dry adhesives. This also avoids the use of additional bonding agents which constitute additives, and as indicated above, additives to the structure of the surgical sponges are generally to be avoided.

Figure 2 is a fragmentary plan view of the structure of Figure 1, illustrating an exemplary form of spot bonding. In Figure 2 the laparotomy sponge is illustrated as being uniformly heat point bonded by individual point bonds 9, arranged in rows 10. The rows 10, in turn, are arranged in a decorative "chevron" pattern. The spot bonding illustrated in Figure 2 is exemplary only. Continuous or discontinuous pattern bonding, uniform or random point bonding or combinations thereof could be used, as is well known in the art.

It will be understood by one skilled in the art that at each individual bond position, the sponge structure is stiffened and its absorptive properties are reduced. Nevertheless, when appropriately designed and positioned, the bonds 9 will cause no appreciable effect on the hand of the overall surgical sponge structure and no significant effect on its absorptive properties.

Figure 3 illustrates a laparotomy sponge generally indicated at 11 comprising a plurality of nonwoven absorbent plies 12 through 15. The absorbent plies 12 and 13 and the absorbent plies 14 and 15 are separated from each other by nonwoven, hydrophobic, thermoplastic plies 16 and 17. The centermost absorptive layers or plies 13 and 14 are separated from each other by a pair of nonwoven, hydrophobic, thermoplastic plies 18 and 19. The plies 18 and 19 are of a different polymer than the plies 16 and 17. An example of the laparotomy sponge 11 was made up wherein all of the absorptive layers 12, 13 and 14 and 15, were "Bemliese" webs and hydrophobic layers 16 and 17 were "Delnet" webs. Plies 18 and 19 were identical "Sharnet" webs, positioned adjacent each other and constituting one centermost hydrophobic thermoplastic layer between absorbent layers 13 and 14.

Yet another embodiment of laparotomy sponge is generally indicated at 20 in Figure 4. In this embodiment a plurality of absorptive layers 21 through 24 are separated by a plurality of hydrophobic thermoplastic layers 25 through 27. In an example made up in accordance with the structure of Figure 4, the absorptive layers 21 through 24 comprised webs of "Bemliese" while the hydrophobic layers 25 through 27 comprised webs of "Sharnet". It will be apparent that the laparotomy sponge 20 of Figure 4 is similar to laparotomy sponge 1 of Figure 1, differing only in that "Sharnet" webs were used for the hydrophobic thermoplastic layers, rather than webs of "Delnet".

Another laparotomy sponge embodiment is generally indicated at 28 in Figure 5. Once again, the sponge comprises a plurality of nonwoven absorbent layers 29 through 32. Layers 29 and 30 and layers 31 and 32 are separated, respectively, by nonwoven, hydrophobic, thermoplastic layers 33 and 34 of the same polymer. The centermost layer 35, separating absorbent layers 30 and 31, constitutes a nonwoven, hydrophobic, thermoplastic layer different in polymer make-up from layers 33 and 34. In an actual laparotomy sponge made in accordance with the structure 28 of Figure 5, the absorbent layers 29 through 32 constituted "Bemliese" webs. The hydrophobic layers 33 and 34 were "Sharnet" webs while the hydrophobic layer 35 was a "Delnet" web.

In all of the embodiments of Figures 1 through 5, the layers of webs making up the laparotomy sponges are heat spot bonded as described with respect to Figure 2.

It will be understood by one skilled in the art that in the exemplary embodiments of Figures 1 through 5 that the absorbent rayon layers need not be identical to each other in structural form, basis weight, or the like. The same is true of the thermoplastic layers, as has been demonstrated. These layers may vary in polymer, structural form or basis weight. For example in laparotomy sponges of the type illustrated in Figures 1 and 4, the individual thermoplastic layers can vary in basis weight. Figures 3 and 5 demonstrate differences in polymer make-up, basis weight and structural form for the thermoplastic layers. It will further be understood that the center thermoplastic layers of Figures 1, 4 and 5 could be made up of at least two plies as is shown in Figure 3. Similarly Figure 3 could have a single ply center thermoplastic layer as in the case of Figures 1, 4 and 5.

The outermost layers of any of the structures of Figures 1 through 5 can be stabilized rayon webs (as indicated above), when outermost layers characterized by improved tensile strength, dimensional stability and resistance to abrasion are particularly desired or required.

It will be understood that the laparotomy sponges 1, 11, 20 and 28 can be provided with radio opaque markers or indicators and loop tapes or handles (not shown), as is well known in the art.

It has been discovered that the amount of water absorbed by an absorbent structure can be increased by adding to that structure alter-

nating layers of non-absorbent material. The amount of water absorbed by the structure is increased by an amount at least as great as if more absorbent material had been added to the structure. This is illustrated by the graph of Figure 6 which shows the result of plying up to 4 layers of "Bemliese", each of a basis weight of 30 g/m^2. Each layer of "Bemliese" is indicated by a small circle. The graph also shows (by means of small squares) the result of adding up to 3 layers of polyethylene "Delnet", each having a basis weight of 18 g/m^2. As can be noted, additional water is absorbed due to the addition of the non-adsorbent material as if an equivalent basis weight of the absorbent material had been added. Thus, it is apparent from Figure 6 that this synergistic absorbency can be stated as follows:

$$S\ (\text{absorbency}) = \frac{A}{B}$$

Where:

S (absorbency)=the synergistic absorbency;

A=is the water absorbed by the structure comprising alternate absorbent and non-absorbent layers; and

B=is the water absorbed by a structure having the same number of absorbent layers without intervening non-absorbent layers.

In general, the synergistic absorbency for the structures of the present invention is in the range of from about 1.1 to about 1.4.

An additional benefit of the structures of the present invention, with respect to this synergistic absorbency, is that the magnitude of the synergism is increased by a factor relating to the number of non-absorbent layers present.

In has also been found that the alternating plies of the non-absorbent material increase the rate at which water is wicked into the structure. This unexpected result constitutes a wicking rate synergism and may be defined as follows:

$$S\ (\text{wicking rate}) = \frac{R_2}{R_1}$$

Where:

S (wicking rate)=the synergistic wicking rate;

R_2=the instantaneous initial rate at which water is taken into the structure comprising alternating absorbent and non-absorbent layers; and

R_1 is the instantaneous initial rate at which water is taken into a structure having the same number of absorbent layers without intervening non-absorbent layers.

In general the synergistic wicking rate for the structures of the present invention is the range of from about 1.3 to about 1.9.

Test procedures

The test procedures used to determine the unique properties of the disposable, nonwoven, absorbent structures of the present invention and to engender the test results provided below are as follows:

Absorbent capacity and wicking rate determined at zero hydrostatic head

The absorbent capacity in grams of water absorbed per grams of sample tested and the rate at which the water is absorbed in grams of water per second is determined using the method described by Bernard M. Lichstein in SYMPOSIUM PAPERS—TECHNICAL SYMPOSIUM—NONWOVEN PRODUCT TECHNOLOGY, March 5—6, 1974, Shoreham Americana, Washington, D.C., pp. 129—142. Exceptions to the method described are: (1) the use of a pressure applied to the sample of 34 newtons per square meter, and (2) the causing of a portion of the sample to momentarily contact the water meniscus to thereby initiate wicking, rather than momentarily pumping the water to the sample. For these determinations, high numbers are desired

Work to break test

A 5.1 cm wide strip of the materials for which these properties are to be determined is tested in an Instron Table Model TM with a tension load cell "C" (range 4.4—22.2 newtons). All test samples are conditioned at least 12 hours at 23±1°C and 50±2% relative humidity. An initial jaw spacing of 5.08 cm is used together with a crosshead speed of 5.08 centimeters per minute. Work to complete break is reported in joules per square meter. A high value is desired.

Dry lint release test

This test uses an electric clothes dryer (without heat) with modifications, and measures the lint or particulate matter released by the test sample in milligrams per square meter. The samples to be tested are conditioned for at least 12 hours at 23±1°C and 50±2% relative humidity. The modifications to the electric dryer include a baffle arrangement to increase sample tumbling action and the use of one-way intake and exhaust filters designed to catch only lint or particulate material released from the test sample. The test sample is allowed to tumble for exactly 30 minutes. Low values are desired.

Examples

The following are examples of structures made in accordance with the teachings of the present invention.

Example 1

A laparotomy sponge of the type illustrated at 1 in Figure 1 was constructed. The absorbent layers 2 through 5 each comprised an unstabilized "Bemliese" web having a basis weight of 30 g/m^2. The hydrophobic thermo-

plastic plies 6 through 8 were polyethylene "Delnet" webs having a basis weight of 18 g/m². The structure was heat spot bonded as described with respect to Figure 2.

Example 2

A laparotomy sponge was assembled in the manner illustrated in Figure 3. In this sponge, the absorbent layers 12 through 15 were unstabilized "Bemliese" webs having a basis weight of 30 g/m². The hydrophobic thermoplastic layers 16 and 17 were polyethylene "Delnet" webs having a basis weight of 18 g/m². The centermost hydrophobic thermoplastic layers 18 and 19 were polypropylene "Sharnet" webs each having a basis weight of 6 g/m² for a total basis weight of 12 g/m² for the centermost hydrophobic thermoplastic layer 18—19. The structure was heat spot bonded in the manner described with respect to Figure 2.

Example 3

A laparotomy sponge was made up after the manner illustrated in Figure 4. In this sponge, the absorbent layers 21 through 24 constituted unstabilized "Bemliese" webs having a basis weight of 30 g/m². The hydrophobic thermoplastic layers 25 through 27 were polypropylene "Sharnet" webs each having a basis weight of 6 g/m². The structure was heat spot bonded as described with respect to Figure 2.

Example 4

A laparotomy sponge of the type illustrated at 28 in Figure 5 was made up wherein the absorbent layers 29 through 32 were unstabilized "Bemliese" of a basis weight of 30 g/m². The hydrophobic thermoplastic layers 33 and 34 were polypropylene "Sharnet" webs of a basis weight each of 6 g/m² and the centermost hydrophobic thermoplastic layer 35 was a polyethylene "Delnet" web having a basis weight of 18 g/m². The structure was heat spot bonded as described with respect to Figure 2.

The structures of Examples 1 through 4 were compared to a conventional, commercially available cotton gauze laparotomy sponge from the standpoints of absorbent capacity and wicking rate at zero hydrostatic head, work to break and linting. The exemplary cotton gauze laparotomy sponge was a 4-ply sponge sold by Kendall Hospital Products of Boston, Massachusetts under the mark "Kerlix". The gauze sponge was a single-use product having been washed, vacuumed and sterilized so as to be ready for use. The results of these comparisons are summarized in Tables I and II below:

TABLE I

Sample	Absorbent capacity at zero hydrostatic head (g/g)	Wicking rate at zero hydrostatic head (g/sec)
Cotton gauze Sponge	4.0	0.04
Example 1 Sponge	11.8	0.38
Example 2 Sponge	11.8	0.22
Example 3 Sponge	12.8	0.27
Example 4 Sponge	13.8	0.24

TABLE II

Samples	Work to break (joules/M²)				Lint (mg/m²)	Basis weight (g/m²)
	Dry		Wet			
	MD	CD	MD	CD		
Cotton gauze Sponge	701	350	858	403	128	114
Example 1 Sponge	1699	1367	1121	1051	7	174
Example 2 Sponge	1156	1314	841	420	7	170
Example 3 Sponge	1156	1139	718	666	7	141
Example 4 Sponge	1284	1367	818	922	7	152

It can be seen that the Examples of the present invention have much improved absorption and linting properties and improved strength as measured by work to break.

The spunbonded or discontinuous fiber rayon absorbent layers of the structures of the invention, while preferably all rayon, may contain other filaments or fibers in an amount such that they will not detract from the performance and aesthetics of the absorbent rayon layers. Mechanical treatment of the layered structures, e.g. by compaction or creping, may also be employed to enhance their softness pliability and conformability.

Claims

1. An absorbent nonwoven structure (1, 11, 20, 28) comprising layers of nonwoven absorbent material (2—5, 12—15, 21—24, 24—32) and nonwoven hydrophobic thermoplastic material (6—8, 16—19, 25—27, 33—35) disposed alternately with absorbent layers (2—5, 12—15, 21—24, 29—32) forming both of the outermost layers, the layers being spot bonded together, characterised in that the absorbent and thermoplastic layers are free of binding and wetting agents, each of the nonwoven hydrophobic thermoplastic layers (6—8, 16—19, 25—27, 33—35) having a basis weight of 5—25 g/m² and an open area of at least 40%, and each thermoplastic layer having a structure such that, when positioned between the absorbent layers, it will provide support therefor and void volume therebetween so as to thereby to increase the absorbency of the structure.

2. A structure according to Claim 1 wherein at least one of said nonwoven absorbent layers (2—5, 12—15, 21—24, 29—32) comprises a spunbonded continuous filament rayon web having a basis weight of from 20 to 75 g/m².

3. A structure according to Claim 1 wherein at least one of said nonwoven absorbent layers comprises a web of discontinuous rayon fibers of at least staple length chosen from the class consisting of an air laid web, a wet laid web, a carded web, an air laid and mechanically needled web, a carded and mechanically needled web, an air laid and hydraulically needled web and a carded and hydraulically needled web, said at least one discontinuous fiber rayon web having a basis weight of from 20 to 75 g/m².

4. A structure according to any one of Claims 1 to 3 wherein said nonwoven hydrophobic thermoplastic layers each comprise at least one web chosen from the class consisting of an expanded film web, an extruded and embossed web, a belt blown web and a spunbonded web made from a polymer chosen from the class consisting of polyethylene, polypropylene, ethyl vinyl acetate, ethylene methyl acrylate, polyester polyamide and polyurethane.

5. A structure according to any one of Claims 1 to 4 wherein said outer most nonwoven absorbent layers (2—5, 12—15, 21—24, 29—32) each comprise a stabilized rayon web.

6. A disposable laparotomy sponge having a structure according to any one of Claims 1 to 4 comprising four absorbent rayon webs of basis weight 30 g/m² and three hydrophobic thermoplastic webs selected from polyethylene webs of basis weight 18 g/m² and polypropylene webs of basis weight 6 g/m².

7. A disposable laparotomy sponge according to Claim 6 characterised in that the absorbent webs comprise continuous filament spunbonded rayon webs (12—15), the two outermost hydrophobic webs (16, 17) being polyethylene webs and the central thermoplastic web comprising two adjacent polypropylene webs (18, 19).

8. A disposable laparotomy sponge according to Claim 6 characterised in that the absorbent webs (29—32) are continuous filament spunbonded rayon webs, the two outermost thermoplastic hydrophobic webs (33, 34) are polypropylene webs and the central thermoplastic web (35) is a single polyethylene web.

Revendications

1. Structure absorbante en non tissé (1, 11, 20, 28), comprenant des couches d'un matériau absorbant non tissé (2—5, 12—15, 21—24, 24—32) et des couches d'un matériau thermoplastique hydrophobe non tissé (6—18, 16—19, 25—27, 33—35), disposées en alternance avec les couches absorbantes (2—5, 12—15, 21—24, 29—32) formant les deux couches des plus extérieures, les couches étant collées par points les unes aux autres, caractérisée en ce que les couches absorbantes et thermoplastiques sont exemptes d'agents liants et mouillants, chacune des couches thermoplastiques hydrophobes non tissées (6—8, 16—19, 25—27, 33—35) ayant un grammage de 5—25 g/m² et une section d'ouverture d'au moins 40%, et chaque couche thermoplastique ayant une structure telle que, quand elle est placée entre les couches absorbantes, elle leur forme un support et laisse un volume creux entre elles de façon à augmenter le pouvoir absorbant de la structure.

2. Structure selon la revendication 1, dans laquelle au moins l'une des couches absorbantes non tissées (2—5, 12—15, 21—24, 29—32) comprend une feuille de rayonne de filaments continus assemblés par torsion ayant un grammage de 20 à 70 g/m².

3. Structure selon la revendication 1, dans laquelle au moins l'une des couches absorbantes non tissées comprend une feuille de fibres de rayonne discontinues ayant au moins la longueur des fibres longues, choisie dans la classe comprenant une feuille déposée pneumatiquement, une feuille déposée par voie humide, une feuille cardée, une feuille déposée

pneumatiquement et mécaniquement aiguilleté, une feuille cardée et mécaniquement aiguilletée, une feuille déposée pneumatiquement et hydrauliquement aiguilletée, une feuille cardée et hydrauliquement aiguilletée, cette feuille de rayonne de fibres discontinues ayant un grammage de 20 à 75 g/m².

4. Structure selon l'une quelconque des revendications 1 à 3, dans laquelle les couches thermoplastiques hydrophobes non tissées comprennent chacune une feuille choisie dans la classe comprenant une feuille en film expansé, une feuille extrudée et gaufrée, une feuille soufflée à la fusion et une feuille assemblée par torsion, préparées à partir d'un polymère choisi dans la classe comprenant le polyéthylène, le polypropylène, l'acétate d'éthyle et de vinyle, l'acrylate d'éthylène et de méthyle, les polyesters, polyamides et polyuréthanes.

5. Structure selon l'une quelconque des revendications 1 à 4, dans laquelle les couches absorbantes non tissées extérieures (2—5, 12—15, 21—24, 29—32) comprennent chacune une feuille de rayonne stabilisée.

6. Eponge à jeter pour laparotomie, ayant une structure selon l'une quelconque des revendications 1 à 4, comprenant quatre feuilles de rayonne absorbantes de grammage 30 g/m² et trois feuilles thermoplastiques hydrophobes choisies parmi les feuilles de polyéthylène ayant un grammage de 18 g/m² et de feuilles de polypropylène ayant un grammage de 6 g/m².

7. Eponge à jeter pour laparatomie selon la revendication 6, caractérisée en ce que les feuilles absorbantes comprennent des feuilles de rayonne liées par torsion (12—15), les deux feuilles hydrophobes extérieures (16, 17) étant des feuilles de polyéthylène et la feuille thermoplastique centrale comprenant deux feuilles de polypropylène adjacentes (18, 19).

8. Eponge à jeter pour laparatomie selon la revendication 6, caractérisée en ce que les feuilles adsorbantes (29—32) sont des feuilles de rayonne liées par torsion, les deux feuilles hydrophobes thermoplastiques extérieures (33, 34) sont des feuilles de polypropylène et la feuille thermoplastique centrale (35) est une feuille unique de polyéthylène.

Patentansprüche

1. Absorbierende Vliesstruktur (1, 11, 20, 28) enthaltend Lagen aus absorbierendem Vliesstoff (2—5, 12—15, 21—24, 29—31) und hydrophobem thermoplastischem Vliesstoff (6—8, 16—19, 25—27, 33—35), der abwechselnd mit den absorbierenden Lagen (2—5, 12—15, 21—24, 29—32) angeordnet ist, die die beiden äussersten Lagen bilden, wobei die Lagen miteinander punktförmig verbunden sind, dadurch gekennzeichnet, dass die absorbierenden und die thermoplastischen Lagen frei von Bindeund Netzmitteln sind, wobei jede der hydrophoben thermoplastischen Vliesstofflagen (6—8, 16—19, 25—17, 33—35) ein Flächengewicht von 5 bis 25 g/m² und eine offene Fläche von mindestens 40% aufweist und jede thermoplastische Lage eine Struktur aufweist, die derart ist, dass, wenn sie sich zwischen den absorbierenden Lagen befindet, sie eine Stütze dafür und Leervolumen dazwischen schafft, so dass die Absorptionsfähigkeit der Struktur erhöht wird.

2. Struktur nach Anspruch 1, worin mindestens eine der absorbierenden Vlieslagen (2—5, 12—15, 21—24, 29—32) eine Rayonspinnvliesbahn aus endlosen Fasern mit einem Flächengewicht von 20 bis 75 g/m² enthält.

3. Struktur nach Anspruch 1, worin mindestens eine der absorbierenden Vlieslagen eine Bahn aus nicht endlosen Rayonfasern von mindestens Stapellänge enthält, ausgewählt aus der Gruppe einer luftabgelagerten Bahn, einer nass abgelagerten Bahn, einer Krempelvliesbahn, einer luftabgelagerten und mechanisch genadelten Bahn, einer Krempelvlies- und mechanisch genaldelten Bahn, einer luftabgelagerten und hydraulisch genadelten Bahn und einer Krempelvlies- und hydraulisch genadelten Bahn, wobei diese mindestens eine Nicht-Endlosfaser-Rayonbahn ein Flächengewicht von 20 bis 75 g/m² aufweist.

4. Struktur nach einem der Ansprüche 1—3 worin diese hydrophoben thermoplastischen Vlieslagen jeweils mindestens eine Bahn enthalten ausgewählt aus der Gruppe einer expandierten Filmbahn, einer extrudierten und geprägten Bahn, einer schmelzgeblasenen Bahn und einer Spinnvliesbahn hergestellt aus einem Polymer ausgewählt aus der Gruppe eines Polyäthylens, Polypropylens, Ethylvinylacetats, Ethylenmethylacrylats, Polyesterpolyamids und Polyurethans.

5. Struktur nach einem der Ansprüche 1—4 worin diese äussersten absorbierenden Vlieslagen (2—5, 12—15, 21—24, 29—32) jeweils eine stabilisierte Rayonbahn enthalten.

6. Wegwerf-Laparotomie-Schwamm mit einer Struktur nach einem der Ansprüche 1—4, enthaltend vier absorbierende Rayonbahnen mit einem Flächengewicht von 30 g/m² und drei hydrophobe thermoplastische Bahnen ausgewählt aus Polyäthylenbahnen mit einem Flächengewicht von 18 g/m² und Polypropylenbahnen mit einem Flächengewicht von 6 g/m².

7. Wegwerf-Laparotomie-Schwamm nach Anspruch 6, dadurch gekennzeichnet, dass die absorbierenden Bahnen Endlosfaser-Spinnrayonbahnen (12—15) enthalten, wobei die beiden äussersten hydrophoben Bahnen (16, 17) Polyäthylenbahnen sind und die mittlere thermoplastische Bahn zwei gegenüberliegende Polypropylenbahnen (18, 19) enthält.

8. Wegwerf-Laparotomie-Schwamm nach Anspruch 6, dadurch gekennzeichnet, dass die absorbierenden Bahnen (29—32) Endlosfaser-Spinnrayonbahnen, die beiden äussersten

thermoplastischen hydrophoben Bahnen (33, 34) Polypropylenbahnen und die mittlere thermoplastische Bahn (35) eine einzelne Polyäthylenbahn sind.

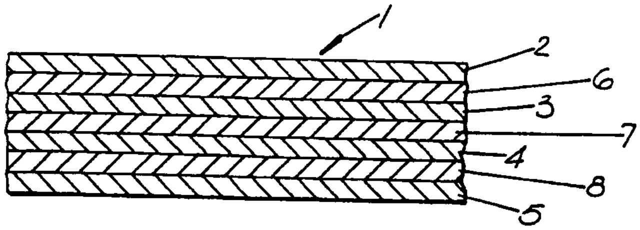

FIG 1

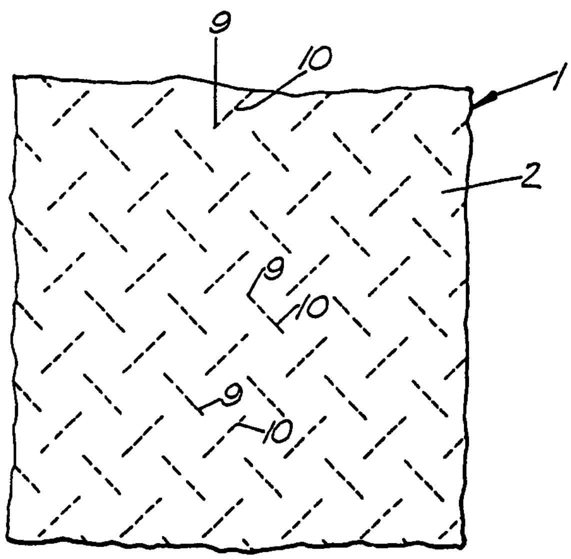

FIG 2

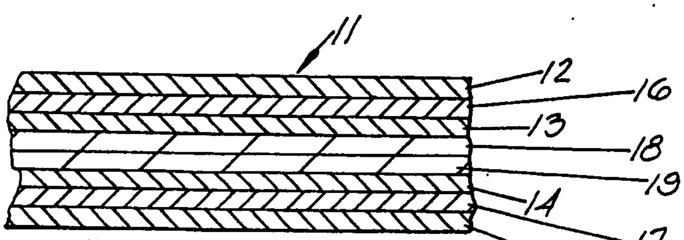

FIG 3

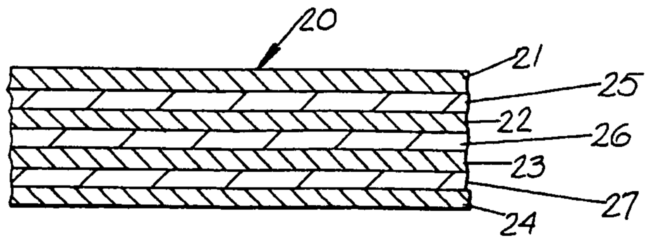

FIG. 4

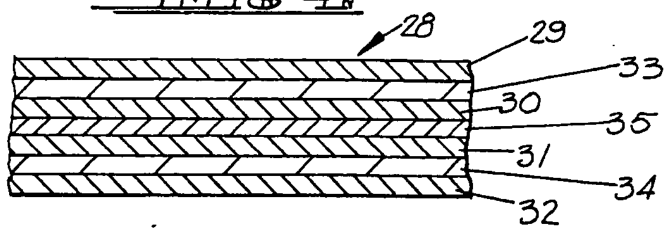

FIG. 5

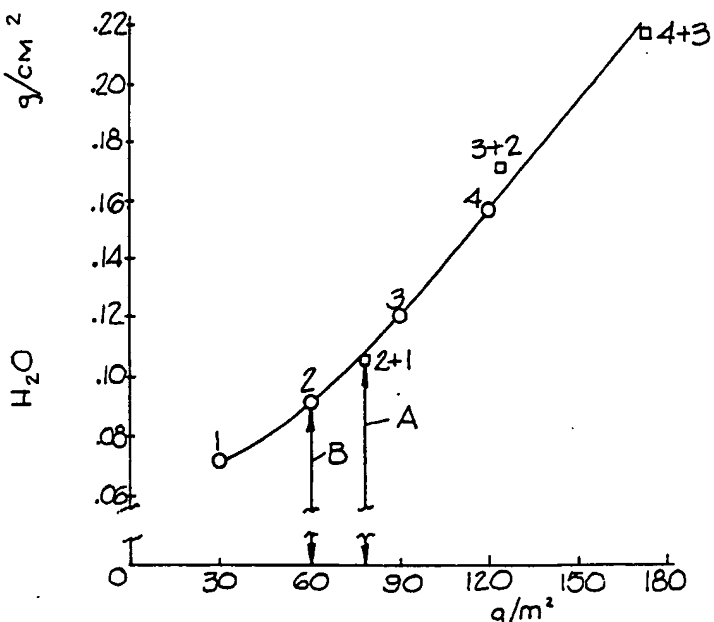

FIG. 6